CLAIMS

1. A magnetic head assembly, having a yoke region between front and back gap regions wherein the front region terminates at an air bearing surface (ABS), comprising:

first and second pole pieces;

first and second coil layers in the yoke region;

the second pole piece having a ferromagnetic pole tip component which forms a portion of the ABS and defines a track width of a write head;

a write gap layer located between the first pole piece and the pole tip component;

a dielectric first insulation layer interfacing first and second side surfaces and a back surface of the pole tip component and located between the first and second coil layers; and

the second pole piece having a ferromagnetic second pole piece structure extending across the second coil layer and magnetically connected to the pole tip component in the front region and the first pole piece in the back gap region.

2. A magnetic head assembly as claimed in claim 1 wherein the first insulation layer is composed entirely of alumina.

3. A magnetic head assembly as claimed in claim 1 including:

the first pole piece having a ferromagnetic pedestal in the front region and a back gap component in the back gap region;

the first coil layer being located between the pedestal and the back gap component of the first pole piece;

a dielectric second insulation layer insulating the first coil layer;

the pedestal and back gap components of the first pole piece, the first coil layer and the second insulation layer forming a first coplanar surface; and

the write gap layer being located between the pedestal and the pole tip component.

4. A magnetic head assembly as claimed in claim 3 including:

the second pole piece having a ferromagnetic back gap component magnetically connected to the back gap component of the first pole piece;

the first insulation layer being located between the pole tip and back gap components of the second pole piece; and

the pole tip and back gap components of the second pole piece and the first insulation layer forming a second coplanar surface.

5. A magnetic head assembly as claimed in claim 4 including:

the second pole piece having a ferromagnetic second pole piece structure that is magnetically connected to the pole tip and back gap components of the second pole piece and that extends across the second coil layer; and

a dielectric third insulation layer insulating the second coil layer from the second pole piece structure.

6. A magnetic head assembly as claimed in claim 5 wherein the second pole piece structure is a single layer.

7. A magnetic head assembly as claimed in claim 6 further including:

a read sensor;

nonmagnetic nonconductive first and second read gap layers;

the read sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first coil layer.

8. A magnetic head assembly as claimed in claim 5 including:

the second pole piece structure having a ferromagnetic yoke between a ferromagnetic front component in the front region and a ferromagnetic back gap component in the back gap region;

the front and back gap components of the second pole piece structure being magnetically coupled to the pole tip and back gap components respectively of the second pole piece;

the front and back gap components of the second pole piece structure and the third insulation layer forming a third coplanar surface; and

the yoke extending across the second coil layer and being magnetically connected to the front and back gap components of the second pole piece structure.

9. A magnetic head assembly as claimed in claim 8 wherein the yoke is a lamination of ferromagnetic and dielectric films.

10. A magnetic head assembly as claimed in claim 9 further including:

a read sensor;

nonmagnetic nonconductive first and second read gap layers;

the read sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first coil layer.

11. A magnetic disk drive, including a write head and a read head that have an air bearing surface (ABS), comprising:

the write head including:

first and second pole pieces;

first and second coil layers in the yoke region;

the second pole piece having a ferromagnetic pole tip component which forms a portion of the ABS and defines a track width of a write head;

a write gap layer located between the first pole piece and the pole tip component;

a dielectric first insulation layer interfacing first and second side surfaces and a back surface of the pole tip component and located between the first and second coil layers; and

the second pole piece having a ferromagnetic second pole piece structure extending across the second coil layer and magnetically connected to the pole tip component in the front region and the first pole piece in the back gap region;

the read head including:

a sensor;

nonmagnetic nonconductive first and second read gap layers;

the sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first pole piece layer;

a housing;

a magnetic disk rotatably supported in the housing;

a support mounted in the housing for supporting the magnetic head assembly with said ABS facing the magnetic disk so that the magnetic head assembly is in a transducing relationship with the magnetic disk;

a spindle motor for rotating the magnetic disk;

an actuator positioning means connected to the support for moving the magnetic head to multiple positions with respect to said magnetic disk; and

a processor connected to the magnetic head, to the spindle motor and to the actuator for exchanging signals with the magnetic head, for controlling movement of the magnetic disk and for controlling the position of the magnetic head.

12. A magnetic disk drive as claimed in claim 11 including:

the first pole piece having a ferromagnetic pedestal in the front region and a back gap component in the back gap region;

the first coil layer being located between the pedestal and the back gap component of the first pole piece;

a dielectric second insulation layer insulating the first coil layer;

the pedestal and back gap components of the first pole piece, the first coil layer and the second insulation layer forming a first coplanar surface; and

the write gap layer being located between the pedestal and the pole tip component.

13. A magnetic disk drive as claimed in claim 12 including:

the second pole piece having a ferromagnetic back gap component magnetically connected to the back gap component of the first pole piece;

the first insulation layer being located between the pole tip and back gap components of the second pole piece; and

the pole tip and back gap components of the second pole piece and the first insulation layer forming a second coplanar surface.

14. A magnetic disk drive as claimed in claim 13 including:

the second pole piece having a ferromagnetic second pole piece structure that is magnetically connected to the pole tip and back gap components of the second pole piece and that extends across the second coil layer; and

a dielectric third insulation layer insulating the second coil layer from the second pole piece structure.

15. A magnetic disk drive as claimed in claim 14 wherein the second pole piece structure is a single layer.

16. A magnetic disk drive as claimed in claim 14 including:

the second pole piece structure having a ferromagnetic yoke between a ferromagnetic front component in the front region and a ferromagnetic back gap component in the back gap region;

the front and back gap components of the second pole piece structure being magnetically coupled to the pole tip and back gap components respectively of the second pole piece;

the front and back gap components of the second pole piece structure and the third insulation layer forming a third coplanar surface; and

the yoke extending across the second coil layer and being magnetically connected to the front and back gap components of the second pole piece structure.

17. A magnetic disk drive as claimed in claim 16 wherein the yoke is a lamination of ferromagnetic and dielectric films.

18. A magnetic head assembly partially bounded by a top surface, a bottom surface and a front surface that forms a portion of an air bearing surface comprising:

first and second pole pieces;

the first pole piece having a ferromagnetic first pole piece layer having front, middle and back portions with the middle portion located between front and back portions;

the first pole piece further having a ferromagnetic pedestal magnetically coupled to the front portion of the first pole piece layer and a ferromagnetic back gap component magnetically coupled to the back portion of the first pole piece layer with the middle portion of the first pole piece layer located between the pedestal and the back gap component;

a dielectric first insulation layer on the middle portion of the first pole piece layer;

a first coil layer located on the first insulation layer which has spaced apart turns and which is spaced from each of the pedestal and the back gap component;

a dielectric second insulation layer located between the turns of the first coil layer and between the first coil layer and each of the pedestal and the back gap component;

the pedestal, the second insulation layer and the back gap component having top surfaces which form a first coplanar surface;

the first coplanar surface having front, middle and back portions with the middle portion located between front and back portions;

a nonmagnetic write gap layer located on the front and middle portions of the first coplanar surface;

the write gap layer having front and rear portions;

the second pole piece having a ferromagnetic pole tip component which is located on the front portion of the write gap layer and which has a width that defines a track width of the write head;

the second pole piece further having a ferromagnetic back gap component magnetically coupled to the back gap component of the first pole piece;

a dielectric third insulation layer located on the rear portion of the write gap layer in a space between the pedestal and the first back gap component of the second pole piece;

the pole tip component, the third insulation layer and the back gap component of the second pole piece having top surfaces which form a second coplanar surface;

the second coplanar surface having front, middle and back portions with the middle portion located between the front and back portions;

a second coil layer located on the middle portion of the second coplanar surface;

the second pole piece having a second pole piece structure located over the second coil layer and magnetically connected to the pole tip component at the front portion of the second coplanar surface and magnetically connected to the back gap component of the second pole piece at the back portion of the second coplanar surface; and

a dielectric fourth insulation layer located between the turns of the second coil layer and between the second coil layer and the second pole piece structure.

19. A magnetic head assembly as claimed in claim 18 including:

the pole tip component having first and second side walls that intersect the ABS; and

the third insulation layer interfacing the first and second side walls of the pole tip component.

20. A magnetic head assembly as claimed in claim 19 wherein the second pole piece structure is a single layer.

21. A magnetic head assembly as claimed in claim 20 wherein the first coil layer has a top surface also forms said first coplanar surface.

22. A magnetic head assembly as claimed in claim 21 wherein the second insulation layer is a first film of photoresist covering the first coil layer and a second film of alumina covering the first film.

23. A magnetic head assembly as claimed in claim 22 further including:

a read sensor;

nonmagnetic nonconductive first and second read gap layers;

the read sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first coil layer.

24. A magnetic head assembly as claimed in claim 23 wherein the third insulation layer is entirely alumina.

25. A magnetic head assembly as claimed in claim 19 wherein the second pole piece structure includes:

a ferromagnetic front component magnetically connected to the pole tip component at the front portion of the second coplanar surface and a ferromagnetic back gap component magnetically connected to the back gap component of the second pole piece at the back portion of the second coplanar surface; and

a ferromagnetic yoke having a front portion magnetically connected to the front component, a back portion magnetically connected to the back gap component of the second pole piece structure and a middle portion extending across and on top of the second coil layer.

26. A magnetic head assembly as claimed in claim 25 wherein the yoke is an entirely flat layer and is laminated with ferromagnetic and dielectric films.

27. A magnetic head assembly as claimed in claim 26 wherein the second insulation layer is a first film of photoresist covering the first coil layer and a second film of alumina covering the first film.

28. A magnetic head assembly as claimed in claim 27 wherein the fourth insulation layer includes a first film of photoresist covering the second coil layer and a second film of alumina covering the first film.

29. A magnetic head assembly as claimed in claim 28 further including:

a read sensor;

nonmagnetic nonconductive first and second read gap layers;

the read sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first coil layer.

30. A method of making a magnetic head, having an air bearing surface (ABS), comprising:

forming first and second pole pieces;

forming first and second coil layers in the yoke region;

forming the second pole piece with a ferromagnetic pole tip component which forms a portion of the ABS and defines a track width of a write head;

forming a write gap layer between the first pole piece and the pole tip component;

forming a dielectric first insulation layer interfacing first and second side surfaces and a back surface of the pole tip component and located between the first and second coil layers; and

forming the second pole piece with a ferromagnetic second pole piece structure extending across the second coil layer and magnetically connected to the pole tip component in the front region and the first pole piece in the back gap region.

31. A method as claimed in claim 30 wherein the first insulation layer is formed entirely of alumina.

32. A method as claimed in claim 30 including the steps of:

forming the first pole piece with a ferromagnetic pedestal in the front region and a back gap component in the back gap region;

forming the first coil layer between the pedestal and the back gap component of the first pole piece;

forming a dielectric second insulation layer insulating the first coil layer;

forming the pedestal and back gap components of the first pole piece, the first coil layer and the second insulation layer defining a first coplanar surface; and

forming the write gap layer between the pedestal and the pole tip component.

33. A method as claimed in claim 32 wherein the first and second coplanar surfaces are formed by chemical mechanical polishing.

34. A method as claimed in claim 32 wherein the second insulation layer is formed protecting the first coil layer before forming the pedestal and back gap component of the first pole piece.

35. A method as claimed in claim 32 including the steps of:

forming the second pole piece with a ferromagnetic back gap component magnetically connected to the back gap component of the first pole piece;

forming the first insulation layer between the pole tip and back gap components of the second pole piece; and

forming the pole tip and back gap components of the second pole piece and the first insulation layer to define a second coplanar surface.

36. A method as claimed in claim 35 including the steps of:

forming the second pole piece with a ferromagnetic second pole piece structure that is magnetically connected to the pole tip and back gap components of the second pole piece and that extends across the second coil layer; and

forming a dielectric third insulation layer insulating the second coil layer from the second pole piece structure.

37. A method as claimed in claim 36 wherein the second pole piece structure is formed as a single layer.

38. A method as claimed in claim 37 including:

forming the second insulation layer of a first film of photoresist and a second film of alumina; and

forming the first film of the second insulation layer to protect the first coil layer before forming the pedestal and the back gap component of the first pole piece and forming the second film after forming the pedestal and the back gap component of the first pole piece.

39. A method as claimed in claim 38 wherein the third insulation layer is formed to protect the second coil layer before forming the front and back gap components of the second pole piece structure.

40. A method as claimed in claim 39 further including the steps of:

forming a read sensor;

forming nonmagnetic nonconductive first and second read gap layers with the read sensor located between the first and second read gap layers; and

forming a ferromagnetic first shield layer with the first and second read gap layers being located between the first shield layer and the first coil layer.

41. A method as claimed in claim 36 including the steps of:

forming the second pole piece structure with a ferromagnetic yoke between a ferromagnetic front component in the front region and a ferromagnetic back gap component in the back gap region;

forming the front and back gap components of the second pole piece structure magnetically coupled to the pole tip and back gap components respectively of the second pole piece;

forming the front and back gap components of the second pole piece structure and the third insulation layer to define a third coplanar surface; and

forming the yoke across the second coil layer and magnetically connecting it to the front and back gap components of the second pole piece structure.

42. A method as claimed in claim 41 including:

forming the second insulation layer of a first film of photoresist and a second film of alumina; and

forming the first film of the second insulation layer to protect the first coil layer before forming the pedestal and the back gap component of the first pole piece and forming the second film after forming the pedestal and the back gap component of the first pole piece.

43. A method as claimed in claim 42 including:

forming the third insulation layer of a first film of photoresist and a second film of alumina; and

forming the first film of the third insulation layer to protect the second coil layer before forming the front and back gap components of the second pole piece structure and forming the second film after forming the front and back gap components of the second pole piece structure.

44. A method as claimed in claim 43 wherein the yoke is formed as a lamination of ferromagnetic and dielectric films.

45. A method as claimed in claim 44 further including the steps of:

forming a read sensor;

forming nonmagnetic nonconductive first and second read gap layers with the read sensor located between the first and second read gap layers; and

forming a ferromagnetic first shield layer with the first and second read gap layers being located between the first shield layer and the first coil layer.

46. A method of making a magnetic head partially bounded by a top surface, a bottom surface and a front surface that forms a portion of an air bearing surface comprising the steps of:

forming first and second pole pieces;

the first pole piece being formed with a ferromagnetic first pole piece layer having front, middle and back portions with the middle portion located between front and back portions;

the first pole piece further being formed with a ferromagnetic pedestal magnetically coupled to the front portion of the first pole piece layer and a ferromagnetic back gap component magnetically coupled to the back portion of the first pole piece layer with the middle portion of the first pole piece layer located between the pedestal and the back gap component;

forming a dielectric first insulation layer on the middle portion of the first pole piece layer;

forming a first coil layer on the first insulation layer with spaced apart turns and spaced from each of the pedestal and the back gap component;

forming a dielectric second insulation layer between the turns of the first coil layer and between the first coil layer and each of the pedestal and the back gap component;

forming the pole tip pedestal, the second insulation layer and the back gap component with top surfaces which form a first coplanar surface with the first coplanar surface having front, middle and back portions with the middle portion located between front and back portions;

forming a nonmagnetic write gap layer on the front and middle portions of the first coplanar surface with the write gap layer having front and rear portions;

forming the second pole piece with a ferromagnetic pole tip component which is located on the front portion of the write gap layer and which has a width that defines a track width of the write head;

further forming the second pole piece with a ferromagnetic back gap component magnetically coupled to the back gap component of the first pole piece;

forming a dielectric third insulation layer on the rear portion of the write gap layer in a space between the pedestal and the first back gap component of the second pole piece;

forming the pole tip component, the third insulation layer and the back gap component of the second pole piece having top surfaces which form a second coplanar surface with the second coplanar surface having front, middle and back portions with the middle portion located between the front and back portions;

forming a second coil layer located on the middle portion of the second coplanar surface;

forming the second pole piece with a second pole piece structure over the second coil layer and magnetically connected to the pole tip component at the front portion of the second coplanar surface and magnetically connected to the back gap component of the second pole piece at the back portion of the second coplanar surface; and

forming a dielectric fourth insulation layer located between the turns of the second coil layer and between the second coil layer and the second pole piece structure.

47. A method as claimed in claim 46 including the steps of:

forming the pole tip component with first and second side walls that intersect the ABS; and

forming the third insulation layer interfacing the first and second side walls of the pole tip component.

48. A method as claimed in claim 47 wherein the second pole piece structure is formed as a single layer.

49. A method as claimed in claim 48 wherein the first coil layer is formed with a top surface that also forms said first coplanar surface.

50. A method as claimed in claim 49 including the steps of:

forming the second insulation layer of a first film of photoresist and a second film of alumina; and

forming the first film of the second insulation layer on the first coil layer to protect the first coil layer before forming the pedestal and the back gap component of the first pole piece and forming the second film of the second insulation layer after forming the pedestal and the back gap component of the first pole piece.

51. A method as claimed in claim 50 further including the steps of:

forming a read sensor;

forming nonmagnetic nonconductive first and second read gap layers with the read sensor located between the first and second read gap layers; and

forming a ferromagnetic first shield layer with the first and second read gap layers located between the first shield layer and the first coil layer.

52. A method as claimed in claim 51 wherein the third insulation layer is formed entirely of alumina.

53. A method as claimed in claim 47 wherein a making of the second pole piece component includes the steps of:

forming a ferromagnetic front component magnetically connected to the pole tip component at the front portion of the second coplanar surface and a ferromagnetic back gap component magnetically connected to the back gap component of the second pole piece at the back portion of the second coplanar surface; and

forming a ferromagnetic yoke having a front portion magnetically connected to the front component, a back portion magnetically connected to the back gap component of the second pole piece structure and a middle portion extending across and on top of the second coil layer.

54. A method as claimed in claim 53 wherein the yoke is formed entirely flat.

55. A method as claimed in claim 54 including the steps of:

forming the second insulation layer of a first film of photoresist and a second film of alumina; and

forming the first film of the second insulation layer on the first coil layer to protect the first coil layer before forming the pedestal and the back gap component of the first pole piece and forming the second film of the second insulation layer after forming the pedestal and the back gap component of the first pole piece.

56. A method as claimed in claim 55 including the steps of:

forming the fourth insulation layer of a first film of photoresist and a second film of alumina; and

forming the first film of the fourth insulation layer on the second coil layer before forming the front and back gap components of the second pole piece structure and forming the second film of the fourth insulation layer on the first film of the fourth insulation layer after forming the front and back gap components of the second pole piece structure.

57. A method as claimed in claim 56 further including:

forming a read sensor;

forming nonmagnetic nonconductive first and second read gap layers with the read sensor located between the first and second read gap layers; and

forming a ferromagnetic first shield layer with the first and second read gap layers located between the first shield layer and the first coil layer.